International Journal of Innovation and Applied Studies
ISSN 2028-9324 Vol. 6 No. 2 June 2014, pp. 269-276

http://www.ijias.issr-journals.org/

PROPOSAL OF A SCENARIO BASED ON NICT FOR INDUSTRIAL MAINTENANCE WORK

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ABSTRACT: According to the new economic and social challenges, the underlying global changes arising from globalization and the new competitive environment. Also, Technological development and that of the New Information and Communication Technologies NICT, and the race of competitiveness that drives the search for the total quality and the reduce costs and deadlines. The integration of NICT in different departments of the company has a positive impact in improving the performance of the company.
The industrial maintenance can take advantage of benefits with regard to the exploitation of its technologies in their processes to ensure efficient management of maintenance.
In this paper, we present a scenario of industrial remote maintenance based on NICT, while locating the actors study, the various dimensions of use, organization, cooperation and coordination for various maintenance tasks corrective and preventive.

KEYWORDS: NICT, Remote Maintenance, cooperation, coordination.

1 INTRODUCTION

The Industrial Maintenance has long played a curative role whose sole purpose was to restore the equipment in good working condition and reduce downtime. But with the development of control methods and diagnostics, maintenance has evolved to integrate preventive actions, which are systematic deviation (based on periodic checks) or conditional types (vibration analysis of the oils ...), this form of maintenance remains low contribution to the concepts of time and size [5].

The technological development and that of NICT has changed the concept of traditional maintenance to a remote maintenance concept that removes the barriers of time and dimension. This remote maintenance on access technologies, data processing, information and knowledge exchange between actors and remote appears to solve the problem of limited number of maintenance personnel with the skills, versatility and a high-level expertise.

These new forms of service tend to ensure maintenance tasks without physical access to equipment to maintain. Thus, there are two types of remote maintenance: remote maintenance and E-maintenance.

In this article, we will develop a comprehensive scenario based on ICT for industrial maintenance work, taking into account a study of actors, as well as various technical dimensions contributing to the concept of industrial remote maintenance.

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2 THE INDUSTRIAL MAINTENANCE : BETWEEN THE CLASSICAL CONCEPT AND THE MODERN CONCEPT

There are several decades; maintenance is considered a vital action in industrial companies. According to AFNOR standard EN 13306, maintenance is defined as: the set of all technical activities, administrative and management during the life cycle of a well-designed to maintain or restore it to a state in which it can perform a required function. [1]

This classic design maintenance has seen a radical change following the technological development and the concepts of ICT to remote maintenance and E-maintenance. These new forms tend to perform maintenance in real time to minimize repair time of production tools.

We present a scenario based on ICT for industrial maintenance work in the case of remote maintenance, while locating the actors of the virtual environment, as well as various technical aspects.

According to [1], the remote Maintenance is defined as "technique of execution of maintenance without physical access of personnel to the working tool".

The following figure shows the principle of remote maintenance.

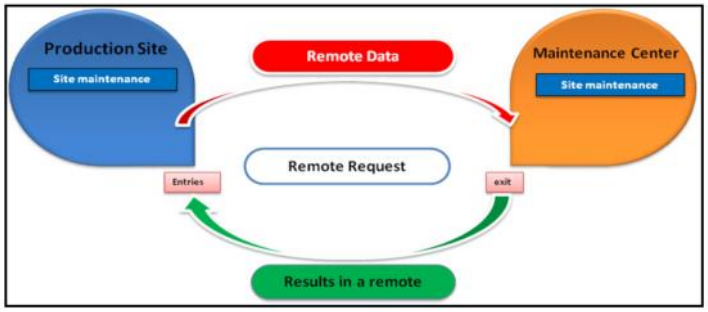

Fig. 1. Principle of remote maintenance

The remote maintenance concept refers to the remote maintenance system via a communication medium; it allows the incorporation remote maintenance activities by the establishment of telecommunications ensuring the distribution of maintenance tasks between functional units and a specialized center (expert).

E-service is an advanced form of remote service which allows making available remote resources, these resources can be material (spare parts, tools, documentation ...) or intangible (human, computer, virtual).

The outsourced resources are accessible through the Internet, tools for communication, exchange and access to information. [9]

Particularly our work is to model a situation of collaborative work for the work of industrial maintenance; FIG. 2 gives an overview of the activity of remote maintenance and disposal of intangible and tangible resources at different locations.

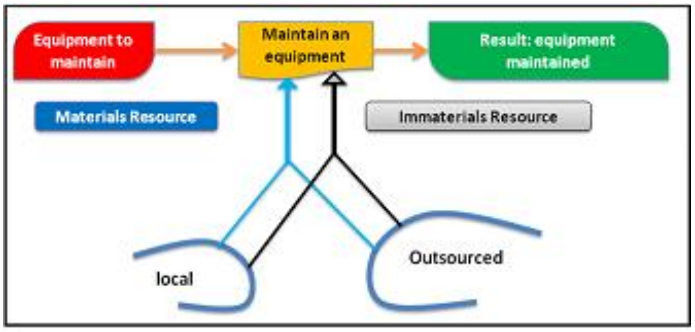

Fig. 2. Activity of the remote maintenance

This environment of tele-working needs more immaterial than material resources to carry out cooperative work provide remote resources.

3 DIFFERENT TOOLS CONTRIBUTING TO THE PROPOSED SCENARIO FOR INDUSTRIAL REMOTE MAINTENANCE

3.1 IMMATERIAL RESOURCES

The objective of our work converges to the design of a cooperative organization proposing the study of the different actors contributing to the virtual work environment [6] protocol. These intangible resources include human resources and virtual resources.

3.1.1 HUMAN RESOURCES

The presence of human resources aims to bring to the organization (or service), the staff necessary for its proper functioning. In our proposal, we need three types of personal power for starting the scenario.

Table 1. Different human resources

Personnel	Specification
Technicians of the site	Engaged in the repair of equipment (corrective maintenance) on the production site, as well as the periodic inspection of equipment (preventive maintenance) in collaboration with a set of local experts on the organization by using a tool NICT. It can manage its work.
Local Experts	Organize the operating modes of the preventive maintenance work for each equipment, the tracking of a stain of repair for the corrective maintenance, the achievement of the standards of repair for the most frequent problems ... The aid to the decision in the case of a new problem. (Nature unidentified)
External Experts	Organize the interventions for the preventive maintenance work as well as corrective concerning a failure unknown by the center of local expertise. The aid to the decision in the case of the lack of competence of local experts (nature non-identified, non-solution identified by the expert local)

3.1.2 VIRTUAL RESOURCES

The presence of human resources for remote maintenance is not enough, this is why the appeal of computer tools (virtual resources) that contain tools to help cooperative work to fill supply work group flexibly as groupware, a database contains all the information that can help validate and perform maintenance work, and finally, the tool of the Internet with a communication interface for real-time interconnection between resources human (technician site expert group, outside expert).

- **The GROUPWARE:**

Groupware or 'software group work' is a collection of applications (Groupware) to facilitate communication, coordination and collaboration between the members of a working group, that is to say, to facilitate cooperation and facilitate effective group work.

In its broadest definition, GROUPWARE means any system that supports collaborative work. It is a technology that covers areas as large as cooperation, human-computer interaction and interpersonal interaction via digital techniques [2].

Generally, a GROUPWARE has the following features: [6]:

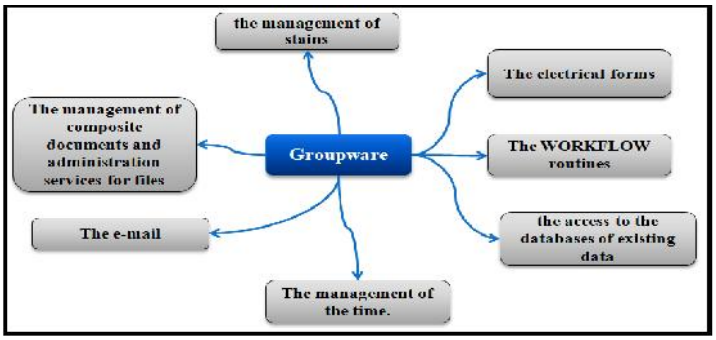

Fig. 3. Features of Groupware

- **Data base**

This tool contains the core of maintenance either preventive or corrective. The existence of this database provides us with technical documentation and knowledge base of each equipment of production to start the industrial remote maintenance scenario.

The following table shows the specification of each base.

Table 2. Components of the data base with their specification

Data base	Specification
Basis of failure	Contains a list of failure for each equipment
Basis of problems	Contains the natures associated with each failure for each equipment
Basis of cases	Contains a list of solutions to meet each problem (list of standards)
Basis of periodic work	Contains a list of works for periodic preventive maintenance for each equipment.
Basis of documentation	Contains a list of digital technical documentation for each device (i.e. its mechanical, electrical, pneumatic, computer, mechatronics ...) Contains a list of audio visual documentation on the mounting and dismounting.
Basis voice support	Contains a list for each case a voice so in the case of overload on the group of experts

- **The Internet & the human machine interface (HMI)**

The Internet offers a diverse enough value via its own speed and low cost making it potentially the most interesting communication medium in the world.

The main advantage of using the Internet is to have access to large amounts of information in real time. Can make decisions on the most recent data and wider. [3]

The internal network of the company and especially the maintenance department is connected to the internet to allow maintenance workers, local or external experts to exchange electronic messages, search for information about an anomaly to have assistance technique, and participate in discussions related to their activities (corrective maintenance, preventive maintenance) to an ugly GUI.

These virtual resources must be integrated into a graphical interface (HMI Human Machine Interface) which allows you to start a cooperative working remotely at the end to make remote maintenance of industrial equipment for assistance via the Internet, while maintaining interoperability between these virtual resources.

This system (HMI) provides access to information support and maintenance [14], and the provision of HTML pages that connects the database and guarantees a remote communication with the personal group (group experts, site technicians, external experts).

4 DESIGN A SCENARIO BASED ON NICT FOR INDUSTRIAL REMOTE MAINTENANCE WORK

4.1 TECHNICAL DIMENSION

Maintenance can be performed in different ways, using different methods and can follow different management. Kaffel proposes a distinction between modes of management of maintenance activities into three categories: [4]

- Do internally, with a service company dedicated to maintenance operations using the methods and strategies desired by the company.
- To do: outsource maintenance work to another company, usually specializing in maintenance.
- Do together: co-process maintenance work with another company within the framework of cooperation agreements, based on a combination of resources. Part of maintenance will be carried out by internal resources belonging to the company.

The total or partial outsourcing of maintenance can improve the conditions for intervention [12], by reducing the time and costs associated with holding action internally expensive [13] resources, increasing equipment reliability.

Our proposal scenario Remote is a mixed manner in order to keep the 3 methods of managing maintenance activities that Kaffel proposed, while maintaining flexibility and interactivity of maintenance work.

The figure.4 presents the organization of human resources in the proposed scenario of remote maintenance.

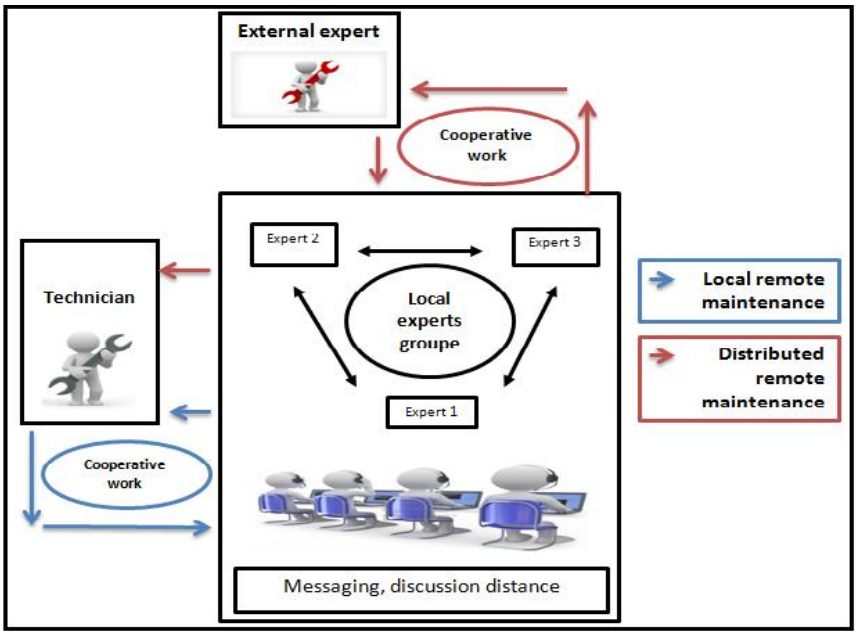

Fig. 4. Organization of human resources

- The service agent can perform corrective maintenance in the case of detection of a fault and the periodic inspection of equipment maintained (same time and same place)
- The maintenance officer finds a difficulty in resolving the failure, so he can ask for help in the decision with a group of local experts. (Same time and different place)
- The maintenance officer and the group of local experts find difficulty in rectifying the problem; in this case the group of local experts may seek decision support to an outside expert (technician provider machine X) according to availability. (Same time or different times and different location)

The following figure locates the concept of the proposed scenario matrix temporal space.

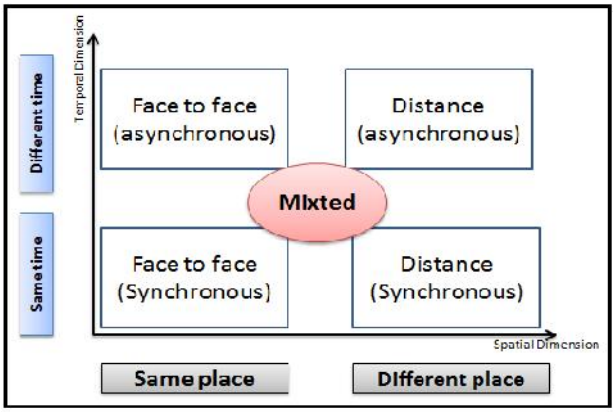

Fig. 5. Space-time matrix

4.2 SCENARIO OF THE INDUSTRIAL REMOTE MAINTENANCE

For corrective maintenance, the technician of the site detects a failure, a full digital record on machine X, if it happens to detect the nature of the failure, the fault becomes an identified problem. Otherwise, the technician starts a conversation with the remote group of local experts to identify the problem, once the nature is found, it must be associated with the failure and automatically saved in the root of the problems, the next step is the resolution of identified problems.

Solving the problem is mainly by the technician of the site if the associated solution to the problem is stored in the base case , if starting a conversation on the diagnosis of the problem (site technician, expert local group or Group local experts with outside expert) to locate a reliable solution (decision support).

Once the solution is found, the phase that comes next is the implementation of the corrective maintenance task by following the instructions in every detail.... Finally the validations of the work for keep the track already done.

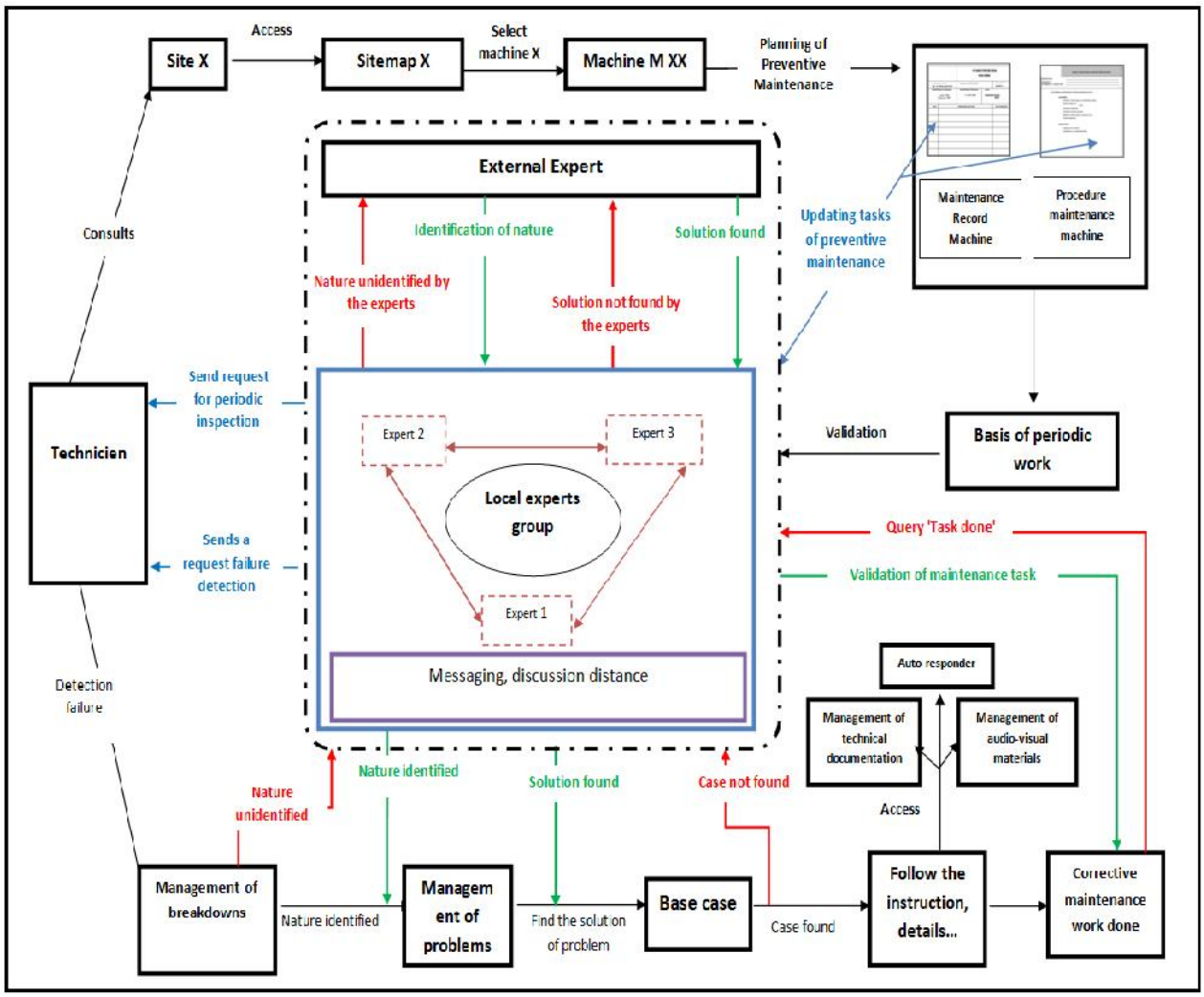

Fig. 6. Scenario of industrial remote maintenance work based on NICT

Regarding the task of preventive maintenance, the group of local experts sends a request to site technician for the periodic inspection of a Machine X, the technician consults the production site by choosing the desired machine for periodic inspection, it between the preventive maintenance schedule while keeping the maintenance procedure and recording in the machine maintenance record. Once the work done, the technician sends a request to the group of local experts to validate the task of preventive maintenance.

The panel refreshes periodic work for each machine, using calculation methods related to maintenance management as indicators MBF (Maintenance based on reliability) [10] as well as methods of quality as the FMECA (Failure Modes, Effects and Criticality Analysis) [11], the Pareto chart (chart 80/20), or the method ... ISHIKAWA, ensuring a reliable systematic forecasting production tools to put in the maintenance procedure (Fig. 6).

5 CONCLUSION

The use of NICT in industrial maintenance keeps a database of firm-specific knowledge regarding its equipment and reduces its capital lately. The effectiveness of NICT use in maintenance requires high expertise for maintenance personnel in the fields of telecommunications and telecommuting. [8]

In this article, we designed a protocol for cooperative work situations of industrial remote maintenance, while locating the various intangible and tangible resources contributing to this virtual environment, as well as the technical dimension concerning the tasks of corrective and preventive maintenance.

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